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## EUROPEAN PATENT APPLICATION

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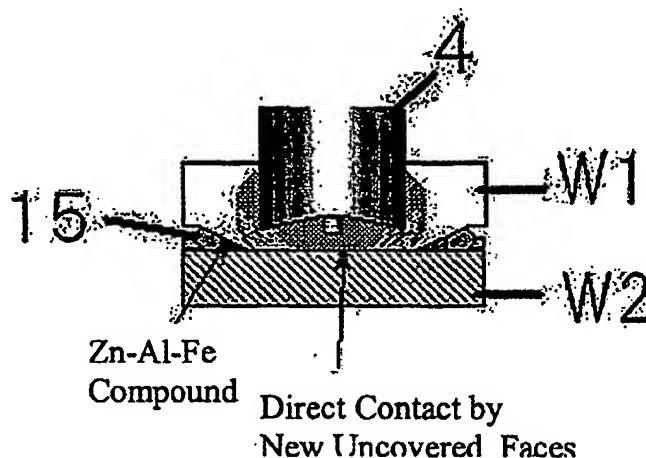
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### (54) Friction stir welding method and friction stir welded structure

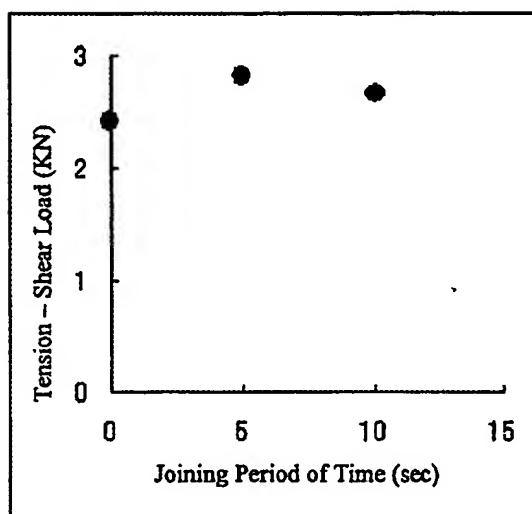
(57) An aluminium plate (W1) and a steel plate (W2) are lapped. A rotating tool (4) is placed on the aluminium plate (W1), and then a pressing force and a rotational force around a pressing axis of the rotating tool (4) are applied to the aluminium plate (W1) and the steel plate (W2). A zinc plating layer (15) having oxidation-prevention function is formed on the surface of the steel plate

(W2) in advance. When joining the both plates (W1, W2) an oxidation film formed on the aluminium plate (W1) is destroyed and the zinc plating layer (15) is pushed out outward from a joining portion, by applying the above pressing force and frictional heat and plastic flow due to the rotation of the rotating tool (4). Thereby, respective new uncovered surfaces of the both plates (W1, W2) are directly contacted.

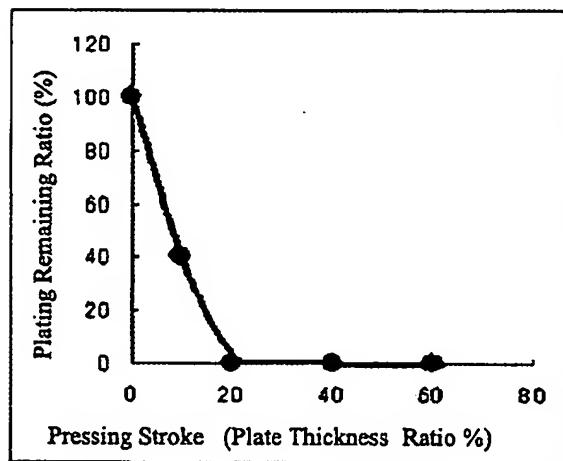
FIG. 9



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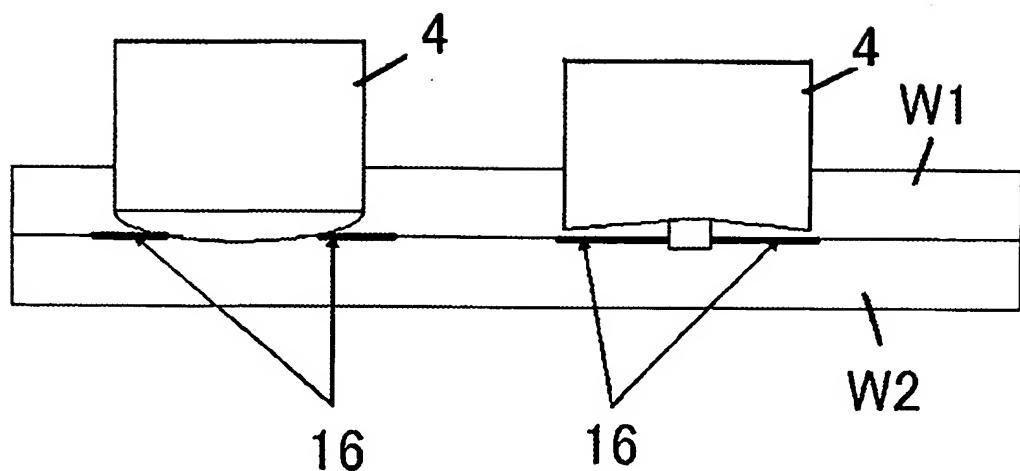


**FIG. 26**



**FIG. 27**

**FIG. 28**





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## EUROPEAN SEARCH REPORT

Application Number  
EP 04 01 6335

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 01/62430 A (BERSAAS JAN CHARLES ; NORSK HYDRO AS (NO); OOSTERKAMP ANTONIE (NO); 00) 30 August 2001 (2001-08-30)	1-8, 10-18	B23K20/12 B23K20/227
Y	* page 1, paragraph 2 * * page 4, lines 7-11 * * page 5, lines 18-20 * * page 6, lines 19-21 * * page 7, lines 10-11 * * figure 3a *	9	
Y,D	PATENT ABSTRACTS OF JAPAN vol. 2002, no. 03, 3 April 2002 (2002-04-03) & JP 2001 314982 A (KAWASAKI HEAVY IND LTD; MAZDA MOTOR CORP), 13 November 2001 (2001-11-13) * abstract * & EP 1 153 694 A (KAWASAKI HEAVY IND LTD) 14 November 2001 (2001-11-14)	9	
X,D	PATENT ABSTRACTS OF JAPAN vol. 2002, no. 07, 3 July 2002 (2002-07-03) & JP 2002 066759 A (MAZDA MOTOR CORP), 5 March 2002 (2002-03-05) * abstract *	1-8, 10-13	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B23K
A		9,14-18	
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 03, 31 March 1999 (1999-03-31) & JP 10 328855 A (SHOWA ALUM CORP), 15 December 1998 (1998-12-15) * abstract; figure 2c *	14-18	
A		1-13	
X	EP 1 291 115 A (BOEING CO) 12 March 2003 (2003-03-12)	12,13	
A		1-11, 14-18	
		-/-	
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	22 October 2004	Jaeger, H	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document B : member of the same patent family, corresponding document	
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Application Number  
EP 04 01 6335

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 14, 31 December 1998 (1998-12-31) & JP 10 230374 A (SHOWA ALUM CORP), 2 September 1998 (1998-09-02) * abstract *	14-18	
			TECHNICAL FIELDS SEARCHED (Int.Cl.)
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	22 October 2004	Jaeger, H	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 04 01 6335

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EOP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-10-2004

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
WO 0162430	A	30-08-2001	AU WO	3782801 A 0162430 A1	03-09-2001 30-08-2001	
JP 2001314982	A	13-11-2001	JP EP US	3429475 B2 1153694 A2 2001045447 A1	22-07-2003 14-11-2001 29-11-2001	
EP 1153694	A	14-11-2001	JP JP EP US	3429475 B2 2001314982 A 1153694 A2 2001045447 A1	22-07-2003 13-11-2001 14-11-2001 29-11-2001	
JP 2002066759	A	05-03-2002		NONE		
JP 10328855	A	15-12-1998		NONE		
EP 1291115	A	12-03-2003	US EP JP	2003042291 A1 1291115 A2 2003126974 A	06-03-2003 12-03-2003 08-05-2003	
JP 10230374	A	02-09-1998		NONE		

EPO FORM P04/04  
For more details about this annex : see Official Journal of the European Patent Office, No. 12/82